

Final

# SUPPLEMENTAL GROUNDWATER INVESTIGATION



**NL/TARACORP  
SUPERFUND SITE  
GRANITE CITY, ILLINOIS**



**Prepared for**

**U.S. Department of the Army  
Corps of Engineers, Omaha District  
Omaha, Nebraska**

**April, 1993**



**Woodward-Clyde Consultants  
2318 Millpark Drive  
St. Louis, Missouri 63043**

**WCC Project No. 89MCT14V**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

77 WEST JACKSON BOULEVARD

CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

Gene Liu  
U.S. Army Corps of Engineers  
215 North 17th Street  
Attn: CEMRO-ED-ED  
Omaha, NE 68102-4978

Dear Mr. Liu:

U.S. EPA and Illinois EPA hereby approve the April 1993  
Supplemental Groundwater Investigation Report. Please contact me (   
at (312) 886-4742 if you have any questions concerning this  
letter.

Sincerely yours,

A handwritten signature in cursive script that reads "Brad W. Bradley".

Brad Bradley  
Remedial Project Manager

cc: Brian Culnan, IEPA



DEPARTMENT OF THE ARMY  
CORPS OF ENGINEERS OMAHA DISTRICT  
215 NORTH 17TH STREET  
OMAHA NEBRASKA 68102-4978

REPLY TO  
ATTENTION OF

April 16, 1993

with Brian (for comments)  
- release to public  
- put in repos 4/27/93  
✓



Environmental Branch

Mr. Brad Bradley (SHS-11)  
U. S. Environmental Protection Agency  
Region V  
Ralph Metcalf Building  
77 West Jackson Boulevard  
Chicago, Illinois 60604

Dear Mr. Bradley:

Enclosed for your review and comment are three (3) copies of the Analytical Results of Groundwater taken at the monitoring wells for the NL Industries/Taracorp Superfund Site, Granite City, Illinois. All comments relating to the report should be submitted not later than May 16, 1993, to the U. S. Army Corps of Engineers, 215 North 17th Street, ATTN: CEMRO-ED-ED (Eugene Liu), Omaha, NE 68102-4978.

If you have any questions, please contact Mr. Liu at telephone number (402) 221-7169.

Sincerely,

*Robert F. Smart*  
S. L. Carlock, P.E.  
Chief, Environmental Branch  
Engineering Division

Enclosure

**SUPPLEMENTAL GROUNDWATER INVESTIGATION:  
THIRD ROUND OF GROUNDWATER SAMPLING  
NL/TARACORP SUPERFUND SITE PREDESIGN FIELD INVESTIGATION**

**1.0**

**INTRODUCTION**

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The Supplemental Groundwater Investigation for the NL/Taracorp Superfund Site (NL Site), in Madison County, Illinois, was conducted as part of Work Order No. 0021 of Woodward-Clyde Consultants (WCC) indefinite delivery contract with the United States Army Corps of Engineers, Omaha District (USACE) (Contract No. DACW45-90-D-0008).

The objective of the third round of groundwater sampling was to provide additional information on groundwater quality for the NL Site. The groundwater investigation consisted of conducting a third groundwater sampling event to attempt to confirm the results of the first two sampling events conducted as part of the Pre-design Field Investigation (PDFI). The groundwater samples were only analyzed for the Target Analyte List metals. The analytical results and field observations for this sampling event are included in this report.

## **2.1 SAMPLING PROCEDURES**

The third round of groundwater sampling was conducted by WCC personnel on March 4 through 8, 1993. Twelve of the 18 monitoring wells were purged and sampled. At the request of the USEPA, a change was made in the sampling procedure. To conform to recent United States Environmental Protection Agency (USEPA) recommendations concerning groundwater sampling for metals (Puls and Barcelona, 1989; see **Appendix A**), purging and sampling were accomplished using a submersible pump instead of a bailer. The new procedure was followed on all but two of the wells that were sampled. On two wells, purging and sampling were completed using a bailer. The pump could not be lowered into well MW-107S due to a damaged well casing. Well MW-107D contained very turbid water that could have damaged the pump.

Eight of the wells which were sampled were constructed of two-inch I.D. PVC screens and risers, and were generally 25 to 35 feet in depth. Four of the wells that were sampled were constructed of two-inch I.D. stainless steel screens and risers. These wells were approximately 70 feet deep and were installed by WCC as part of the PDFI. Four wells could not be sampled: MW-102, MW-105S, MW-106S, and MW-108S were dry with screen settings of 20 to 25 feet. Two of the existing wells, MW-103S and MW-105D, were bent and damaged, and could not be sampled. A well information summary for the third sampling event is included in **Table 1**.

Prior to initiating any intrusive activities at a well site, the sampling team would don a polycoated Tyvek, latex undergloves, and neoprene outergloves. The well cover was unlocked or the flush-mount cover removed. The sampling team measured the water level and total depth of the well by using an electronic water level indicator. The indicator was decontaminated with deionized water as it was removed from the well casing. Conductivity and Ph meters were calibrated with prepared standards. Both PVC and stainless steel bailers were decontaminated prior to use. The decontamination procedure consisted of a wash in

Alconox soap, a tap water rinse, an alcohol rinse and a final deionized water rinse. The submersible pump was also decontaminated before and after each use. The pump was placed in buckets containing Alconox soap, a tap water rinse, an alcohol rinse and a final deionized water rinse. Each of the decontamination solutions was run through the pump and all of the Tygon tubing prior to use at the next well. The exterior of the pump, Tygon tubing, and pump cable were then decontaminated with Alconox soap, a tap water rinse, an alcohol rinse and a final deionized water rinse.

Due to a damaged well casing, well MW-107S could not be purged or sampled using the submersible pump. Instead, a one inch diameter stainless steel bailer was used to purge and sample the well. A new length of clean nylon rope was attached to the bailer. Due to slow recharge, five well volumes could not be removed. The well was purged dry, with approximately 1.5 gallons of water removed. The purge water was placed in a 100 gallon wastewater tank to be disposed of on the Taracorp pile. After purging, the well was allowed to recover prior to sampling. Samples were collected using a one in. diameter stainless steel bailer. The appropriate sample jars were filled for metals analysis. The bailer was decontaminated in accordance with CDAP SOP No. 6. The used rope and used PPE equipment were put into plastic trash bags for proper disposal. The protective well cover was closed and locked.

Well MW-107D could not be purged or sampled with the submersible pump due to excessive turbidity. Instead, a two in. diameter PVC bailer was used to purge the well. A new length of clean nylon rope was attached to the PVC bailer. Due to slow recharge, five well volumes could not be removed. The well was purged dry, with approximately 12 gallons of water removed. The purge water was placed in a 100 gallon wastewater tank to be disposed of on the Taracorp pile. After purging, the well was allowed to recover prior to sampling. Samples were collected using a two in. diameter stainless steel bailer. The appropriate sample jars were filled for metals analysis. The bailers were decontaminated in accordance with CDAP SOP No. 6. The used rope and used PPE equipment were put into plastic trash bags for proper disposal. The protective well cover was closed and locked.

For the remaining eleven wells that were sampled, a submersible pump was used instead of a bailer to purge the five well volumes. An electric generator was set up downwind from

the well. A new length of nylon rope and Tygon tubing was attached to the pump assembly. This assembly was then lowered into the well after being connected to the pump power converter and generator. After the removal of the five well volumes, the pumping rate was reduced to approximately 500 ml/minute and the appropriate sample containers were filled. (The slowest the submersible pump could deliver a steady stream of water to the surface was 500 ml/minute.) After the sampling was completed, the Tygon tubing, pump, and pump cable were removed from the well and decontaminated in accordance with CDAP SOP No. 6.

If required, bottles for QA/QC were also filled. A separate jar was filled to measure field parameters (pH, conductivity, temperature, and water clarity). The sample jars were decontaminated, dried, and labeled as specified in CDAP SOP No. 3. Samples were then packed in iced coolers to be maintained at a temperature of 4 °C. Field sampling sheets were completed for each sample. Information on sampling sheets included the time of sampling, sampling team members initials, and required analysis.

At the end of each day of sampling, chain-of-custody forms were completed and the sample jars packed in iced coolers for shipment to Ortek Laboratories, in Green Bay, Wisconsin via Federal Express priority overnight delivery. QA samples collected each day were packed in iced coolers and shipped to the USACE-MRD, via Federal Express priority overnight delivery.

## **2.2 LABORATORY METHODOLOGY AND QUALITY CONTROL**

Groundwater samples collected from the NL Site were analyzed for the Target Analyte List (TAL) Metals. Samples were analyzed in accordance with the CDAP and EPA SW-846 procedures and protocols. Groundwater and QC sample analyses were conducted by Ortek Environmental Laboratories (Ortek) in Green Bay, Wisconsin, in accordance with the appropriate SOP's and the Ortek QAPP. QA sample analyses were conducted at the USACE-MRD Laboratory.

The quality control level of effort for the groundwater investigation consisted of collecting and submitting to Ortek these samples:

- 2 Field duplicates
- 1 MS/MSD
- 1 Equipment rinsate blank

The quality assurance level of effort for the groundwater investigation consisted of collecting and submitting to USACE these samples:

- 2 Field duplicates
- 1 MS/MSD
- 1 Equipment rinsate blank

The quality control and quality assurance levels of effort are summarized in Table 2.

The analytical method specific Data Quality Objectives (DQO's) for groundwater samples collected from the NL Site included precision, accuracy, and sensitivity criteria. The QA objective was to achieve the QC acceptance criteria required by the analytical protocols in SW-846. The initial validation of laboratory data was performed by Ortek. WCC conducted an independent validation of the laboratory data packages. A summary of data validation results is presented with the attached analytical data (Appendix B).

Analytical data that was generated which fell within acceptable control limits were judged to be in control. Data generated which fell outside control limits are considered suspect and are reported with qualifiers. Data for all samples appears usable with no qualification necessary.

Two samples, MW-108D and MW-108D Duplicate, are reported with a higher detection limit for selenium due to matrix interference. These samples required a 5X dilution for sample analysis. Data quality was not affected.

Corrective action was applied when any measurement system failed to follow the laboratory QAPP or CDAP Data Quality Objectives. The laboratory QA Supervisor reviewed the data generated to verify that all quality control samples were within the established control limits. Data generated with laboratory control samples that did not fall within control limits were considered suspect, and the sample analysis was repeated or samples results were reported with qualifiers if reanalysis was not possible.

**FIELD OBSERVATIONS**

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The water in the monitoring wells that were sampled was generally clear. Two exceptions were wells MW-101 and MW-107D. In well MW-101, the water was reddish-brown and slightly cloudy. In well MW-107D, the water was light-gray, cloudy, and silty.

Due to field parameter measurements that were inconsistent with field measurements from the first two sampling rounds, an additional set of samples for field parameters only was collected on April 2 through 7, 1993. The initial set of pH measurements for the NL/Taracorp wells ranged from 6.65 to 8.14. The additional set of pH measurements ranged from 6.55 to 7.46. The initial set of groundwater temperatures ranged from 4 to 14 °C. The additional set of groundwater temperatures ranged from 13.0 to 17.7 °C. Conductivities measured on the initial set of samples generally ranged from 980 to 1450 umhos/cm, except for MW-104 and MW-108D. MW-104 had a significantly lower conductivity of 410 umhos/cm, while MW-108D had a high conductivity of 2600 umhos/cm. Conductivities measured on the additional set of samples ranged from 250 to 2100 umhos/cm. The additional set of water quality parameters was very similar to the parameters measured during previous sampling events. A summary of water quality parameters measured during sampling is provided in Table 3.

#### **4.1 METALS**

Groundwater samples were analyzed for 13 metals of concern which included lead, arsenic, cadmium, and chromium. Results of metals analyses are included in **Table 4**; the laboratory data are included in the **Appendix**. All metals except for silver and mercury were detected at concentration levels above reporting limits in at least one sample collected from the monitoring wells (**Table 4**).

Samples from four monitoring wells had lead concentrations greater than the maximum contaminant level (MCL) of 0.015 mg/l promulgated under the Safe Drinking Water Act and which became effective December 1, 1992. These four wells were MW-101 (0.027 mg/l), MW-104-92 (0.043 mg/l), MW-107S (0.087 mg/l), and MW-107D (0.067 mg/l). Monitoring wells located upgradient of the Taracorp pile, MW-110 and MW-111-92, had lead concentrations below the detection limit (<0.002 mg/l). The groundwater samples from MW-107S and MW-107D had the highest lead concentration at 0.087 mg/l and 0.067 mg/l, respectively. Both wells are located west of the Taracorp pile (**Figure 4, PDFI**).

One monitoring well had an arsenic concentration greater than the MCL of 0.05 mg/l. The sample from MW-101, located near the northwest corner of the Taracorp pile (**Figure 4, PDFI**), had an arsenic concentration level at 0.46 mg/l.

Cadmium and chromium were detected at concentrations above their respective MCLs for four monitoring wells. The groundwater sample from MW-108D had a cadmium concentration of 1.9 mg/l, which is above the MCL of 0.05 mg/l. Chromium concentrations in groundwater samples from MW-101 (0.077 mg/l), MW-107S (0.061 mg/l), and MW-107D (0.078 mg/l) were also above the MCL of 0.05 mg/l. The highest chromium concentration was 0.078 mg/l in MW-107D.

Copper was detected in three wells: MW-101 (0.039 mg/l), MW-107S (0.066 mg/l), and MW-107D (0.027 mg/l). Nickel was detected in four wells: MW-101 (0.077 mg/l), MW-107S (0.092 mg/l), MW-107D (0.045 mg/l), and MW-108D (0.17 mg/l). Zinc was detected in four wells also: MW-101 (0.11 mg/l), MW-107S (0.18 mg/l), MW-107D (0.091 mg/l), and MW-108D (7.6 mg/l). Groundwater samples from the four wells had metal concentration ranges of:

- Copper - 0.027 mg/l (MW-107D) to 0.066 mg/l (MW-107S)
- Nickel - 0.045 mg/l (MW-107D) to 0.17 mg/l (MW-108D)
- Zinc - 0.091 mg/l (MW-107D) to 7.6 mg/l (MW-108D)

Quality control samples consisting of field duplicates were taken from MW-108D and MW-111-92. Constituent metal concentration levels for both duplicate samples were representative of the respective groundwater sample (Table 4). Rinsate samples, (MW-112 and MW-114) had metal concentrations that were below the reporting limits, except for zinc which was detected in the rinsate sample MW-114 at 0.055 mg/l. The source of zinc detected in rinsate sample MW-114 is unknown. Since no other metals constituents were detected in the sample it appears unlikely that it was due to field contamination. Based on data validation completed by WCC, there does not appear to be any evidence of laboratory contamination.

## ***TABLES***

**TABLE 1**  
**WELL INFORMATION**  
Groundwater Sampling Event March, 1993  
NL/Taracorp Superfund Site

WELL #	MEASURED TD (FEET)	DIAM. (IN.)	SCREEN INTERVAL (FEET)	SCREEN MATERIAL	RISER ELEV. (MSL)	WATER LEVEL (FEET)	WATER ELEVATION (FEET)	WELL VOLUME (GALS)	PURGE VOLUME (GALS)
101	27.0	2	15-25	PVC	421.45	19.00	402.45	0.98	4.90
102	16.59	2	15-25	PVC	416.58	16.60	399.98	1.37	6.85
103	BENT RISER	2	15-25	PVC	417.17	DRY			
103-91	72.52	2	58.71-68.71	SS	416.89	16.30	400.59	8.76	43.82
104	28.68	2	17-27	PVC	422.25	21.57	400.68	0.89	4.43
104-92	68.35	2	58.12-68.12	SS	418.25	17.75	400.50	8.26	41.31
105S	28.8	2	21-26	PVC	428.66	28.00	400.66		
105D	BENT RISER	2	30.3-35.3	PVC	428.74	28.11	400.63	2.19	
106S	23.47	2	15.79-20.79	PVC	423.71	23.08	400.63		
106D	37.35	2	29.91-34.91	PVC	423.79	23.10	400.69	1.94	9.71
107S	24.35	2	17.46-22.46	PVC	420.78	17.31	403.47	0.77	3.83
107D	37.6	2	30.44-35.44	PVC	421.65	21.12	400.53	2.27	11.33
108S	23.2	2	15.4-20.4	PVC	421.71	21.35	400.36	0.11	0.53
108D	33.15	2	27.26-32.26	PVC	422.71	22.50	400.21	2.04	10.20
109	32.7	2	29-34	PVC	416.64	15.20	401.44	3.23	16.16
109-92	69.98	2	59.26-69.26	SS	415.71	16.02	399.69	8.73	43.65
110	33.82	2	30-35	PVC	418.49	19.30	399.19	2.56	12.81
111-92	67.7	2	57.64-67.64	SS	419.40	19.60	399.80	7.88	39.40

TD = Total Depth

**TABLE 2**  
**GROUNDWATER SAMPLING SUMMARY**  
Groundwater Sampling Event March, 1993  
NL/Taracorp Superfund Site

WELL NUMBER	FIELD SAMPLES	QUALITY ASSURANCE			QUALITY CONTROL		
		FIELD DUPLICATE	MS/MSD	RINSATE BLANKS	FIELD DUPLICATE	MS/MSD	RINSATE BLANKS
101	1						
103-91	1					1 / 1	
104	1						
104-92	1	1	1 / 1				
106D	1						
107S	1						
107D	1						
108D	1				1		
109	1						
109-92	1	1					
110	1						
111-92	1				1		
112							1
113				1			
114							
115							
<b>Total</b>	<b>12</b>	<b>2</b>	<b>1/1</b>	<b>1</b>	<b>2</b>	<b>1/1</b>	<b>1</b>
<b>Frequency (%)</b>		<b>17</b>	<b>8 / 8</b>	<b>8</b>	<b>17</b>	<b>8 / 8</b>	<b>8</b>

Sampling included metals only.

**TABLE 3**  
**WATER QUALITY PARAMETERS**  
**Groundwater Sampling Event March, 1993**  
**NL/Taracorp Superfund Site**

WELL ID	WATER LEVEL (ft)		pH		CONDUCTIVITY ( $\mu$ hos/cm)		TEMP. (°C)	
	March 4-8 1993	April 1-7 1993	March 4-8 1993	April 1-7 1993	March 4-8 1993	April 1-7 1993	March 4-8 1993	April 1-7 1993
MW-101	19.0	18.9	7.90	7.08	1450	1344	10.9	16.3
MW-103-91	16.3	15.6	6.88	6.88	1210	900	13.9	14.5
MW-104	21.6	20.9	6.65	6.55	410	250	10.1	17.0
MW-104-92	17.8	17.0	7.17	7.15	980	800	13.4	15.5
MW-106-D	23.1	22.4	6.81	7.41	1270	750	4.3	14.0
MW-107-S	17.3	17.0	7.15	7.46	1160	1012	3.1	15.9
MW-107-D	21.1	20.4	8.14	7.34	1360	910	8.6	16.5
MW-108-D	22.5	20.6	6.72	6.86	2600	2100	10.4	17.7
MW-109	15.2	14.5	6.95	6.78	1120	750	4.6	15.0
MW-109-92	16.0	15.3	7.04	7.16	1200	900	9.4	13.5
MW-110	19.3	18.2	7.89	7.07	1290	900	11.4	13.0
MW-111-92	19.6	18.6	8.00	7.26	1250	950	13.9	15.5

NOTE 1: Water parameters taken in March were analyzed with a Horiba Water Parameter meter. Parameters taken in April were analyzed with a SCT Conductivity meter and a Orion 230A pH-Temperature meter. April 7th data was analyzed with a Corning Checkmate meter.

NOTE 2: Wells MW-102, MW-103, MW-105-S, MW-106-S, and MW-108-S did not contain enough water to sample and are not included in this table.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-101			MW-103-91			MW 104		
		FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT
Mercury	MG/L	0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.0003	0.0005	<0.0002
Silver	MG/L	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009
Arsenic	MG/L	4.2	0.77	0.46	<0.003	<0.003	<0.003	0.086	0.087	0.0046
Cadmium	MG/L	0.0039	0.0053	<0.006	0.0017	<0.006	<0.006	0.0027	<0.006	<0.006
Chromium	MG/L	0.034	0.018 U	0.077	<0.002	0.029 U	<0.013	0.047	0.098 J	<0.013
Lead	MG/L	0.13	0.023	0.027	0.0027	0.0038	<0.002	0.47	0.42	0.013
Antimony	MG/L	0.014	<0.011	<0.060	<0.002	0.014	<0.060	0.023	0.013	<0.060
Selenium	MG/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Thallium	MG/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Beryllium	MG/L	0.0026	<0.0006	0.0006	<0.0006	<0.0006	<0.0006	0.0019	0.00322	<0.0006
Copper	MG/L	0.06	0.017	0.039	<0.014	<0.014	<0.014	0.064	0.097	<0.014
Nickel	MG/L	0.13	0.027	0.077	<0.023	<0.023	<0.023	0.12	0.19	<0.023
Zinc	MG/L	0.35	0.098	0.11	0.036	0.074 J	<0.020	0.24	0.38 J	<0.020

U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.  
J - The associated numerical value is an estimated quantity.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-104-92			MW-106D			MW-107S		
		FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT
Mercury	MGL	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0006	<0.0002
Silver	MGL	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009
Arsenic	MGL	0.0088	0.0032	<0.003	0.013	0.0032	<0.003	0.044	0.1	0.026
Cadmium	MGL	0.0033	<0.006	<0.006	0.0005	<0.006	<0.006	0.0032	0.01	<0.006
Chromium	MGL	0.002	0.034 J	<0.013	<0.002	0.016 U	<0.013	0.042	0.36 J	0.061
Lead	MGL	0.44	0.27	0.043	0.019	0.019	<0.002	0.14	0.52	0.087
Antimony	MGL	0.007	0.01	<0.060	0.003	<0.011	<0.060	0.008	<0.011	<0.060
Selenium	MGL	<0.003	<0.003	<0.003	0.0077	0.01	0.0098	<0.003	<0.003	<0.003
Thallium	MGL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Beryllium	MGL	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.002	0.0079	0.0019
Copper	MGL	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	0.064	0.3	0.066
Nickel	MGL	<0.023	<0.023	<0.023	<0.023	0.026	<0.023	0.11	0.43	0.092
Zinc	MGL	0.082	0.086 J	<0.020	<0.020	0.067	<0.020	0.25	0.86	0.18

U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-107D			MW-108D			MW 108D QC FIELD DUPLICATE		
		FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT
Mercury	MG/L	<0.0002	0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.0002	<0.0002
Silver	MG/L	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009
Arsenic	MG/L	0.065	0.04	0.024	<0.003	0.018	<0.003	<0.003	0.023	<0.003
Cadmium	MG/L	0.0018	<0.005	<0.005	8.5	9.6	1.9	9.0	9.2	1.9
Chromium	MG/L	0.044	0.067 J	0.078	0.006	0.073 J	0.022	0.006	0.084 J	0.029
Lead	MG/L	0.11	0.12	0.067	0.023	0.14	0.0043	0.026	0.15	0.0038
Antimony	MG/L	0.005	<0.011	0.060	<0.006	0.022	<0.060	<0.002	<0.011	<0.060
Selenium	MG/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.015	<0.003	<0.003	<0.015
Thallium	MG/L	<0.002	<0.002	<0.002	0.046	0.046	0.028	0.048	0.051	0.029
Beryllium	MG/L	0.0016	0.0017	0.0006	<0.0006	0.00202	<0.0006	0.0007	0.00188	<0.0006
Copper	MG/L	0.052	0.054	0.027	<0.014	0.045	<0.014	<0.014	0.044	<0.014
Nickel	MG/L	0.054	0.057	0.045	0.46	0.63	0.17	0.47	0.64	0.18
Zinc	MG/L	0.22	0.25	0.091	28	34	7.6	28	34	7.7

U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.  
J - The associated numerical value is an estimated quantity.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-109			MW-109-92			MW-110		
		FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT
Mercury	MGL	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	MGL	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009
Arsenic	MGL	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	MGL	0.0028	<0.006	<0.006	0.0018	<0.006	<0.006	0.0013	<0.006	<0.006
Chromium	MGL	<0.002	<0.013	<0.013	0.003	0.021 U	<0.013	<0.002	<0.013	<0.013
Lead	MGL	0.0046	0.019	<0.002	0.018	0.0038	<0.002	0.0042	0.017	<0.002
Antimony	MGL	<0.002	<0.011	<0.060	<0.002	<0.011	<0.060	<0.002	<0.011	<0.060
Selenium	MGL	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Thallium	MGL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Beryllium	MGL	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Copper	MGL	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Nickel	MGL	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	0.033	<0.023
Zinc	MGL	0.057	0.077 J	<0.020	0.081	0.067 J	<0.020	0.043	0.078	<0.020

U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.  
J - The associated numerical value is an estimated quantity.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-111-92			MW-111-92 QC FIELD DUPLICATE			MW-112 QC RINSE BLANK		
		FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT	FIRST EVENT	SECOND EVENT	THIRD EVENT
Mercury	MG/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver	MG/L	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009	<0.0004	<0.009	<0.009
Arsenic	MG/L	0.0046	0.0037	<0.003	0.004	<0.003	<0.003	0.0032	<0.003	<0.003
Cadmium	MG/L	<0.0003	<0.006	<0.006	0.0004	<0.006	<0.006	<0.0003	<0.006	<0.006
Chromium	MG/L	<0.002	0.024 U	<0.013	<0.002	0.027 U	<0.013	<0.002	<0.013	<0.013
Lead	MG/L	0.003	0.009	<0.002	0.0094	0.0072	<0.002	<0.002	<0.002	<0.002
Antimony	MG/L	<0.002	<0.011	<0.060	<0.002	<0.011	<0.060	<0.002	<0.011	<0.060
Selenium	MG/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Thallium	MG/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Beryllium	MG/L	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Copper	MG/L	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Nickel	MG/L	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023
Zinc	MG/L	0.043	0.073	<0.020	0.059	0.068	<0.020	<0.020	<0.020	<0.020

U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.  
J - The associated numerical value is an estimated quantity.

**Table 4**  
**Metals Results of Groundwater Sampling Events**  
**NL/Taracorp Superfund Site**

Parameter	Unit	MW-114 QC RINSTATE BLANK	
		FIRST EVENT	SECOND EVENT
Mercury	MG/L	0.0003	<0.0002
Silver	MG/L	<0.0004	<0.0009
Arsenic	MG/L	<0.003	<0.003
Cadmium	MG/L	<0.0003	<0.0005
Chromium	MG/L	<0.002	<0.013
Lead	MG/L	<0.002	<0.002
Antimony	MG/L	<0.002	<0.011
Selenium	MG/L	<0.003	<0.003
Thallium	MG/L	<0.002	<0.002
Beryllium	MG/L	<0.0006	<0.0006
Copper	MG/L	<0.014	<0.014
Nickel	MG/L	<0.023	<0.023
Zinc	MG/L	<0.020	0.055

- U - The compound was analyzed for but was not detected.  
The associated numerical value is attributed to contamination  
and is considered to be the sample quantitation limit.
- J - The associated numerical value is an estimated quantity.

***APPENDIX A***

***GROUND WATER SAMPLING FOR  
METALS ANALYSES***

***R. W. PULS AND M. J. BARCELONA***

# EPA Superfund Ground Water Issue

## Ground Water Sampling for Metals Analyses

Robert W. Puls and Michael J. Barcelona

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange up-to-date information related to ground-water remediation at Superfund sites.

Filtration of ground-water samples for metals analysis is an issue identified by the Forum as a concern of Superfund decision-makers. Inconsistency in EPA Superfund cleanup practices occurs where one EPA Region implements a remedial action based on unfiltered ground-water samples, while another Region may consider a similar site to be clean based on filtered ground-water samples. RSKERL-Ada and EMSL-Las Vegas have convened a technical committee of experts in the areas of ground-water geochemistry, inorganic chemistry, colloidal transport and ground-water sampling technology to examine this issue and provide technical guidance based on current scientific information.

Members of the committee were Robert W. Puls, Bert E. Bledsoe and Don A. Clark of RSKERL; Michael J. Barcelona, Illinois State Water Survey; Philip M. Gschwend, Massachusetts Institute of Technology; Terry F. Rees, USGS-Denver; John W. Hess, Desert Research Institute (EMSL-LV); and Nicholas T. Loux, ERL-Athens.

This document was written by Robert W. Puls and Michael J. Barcelona and edited by all members of the committee.

For further information contact Robert Puls, RSKERL-Ada, FTS 743-2262; Ben Bledsoe, RSKERL-Ada, FTS 743-2324; Jane Denne, EMSL-LV, FTS 545-2655.

The findings and recommendations of the committee were that use of a 0.45 micron\* filter was not useful, appropriate or

reproducible in providing information on metals mobility in ground-water systems, nor was it appropriate for determination of truly "dissolved" constituents in ground water. A dual sampling approach was recommended, with collection of both filtered and unfiltered samples. If the purpose of the sampling is to determine possible mobile contaminant species, the unfiltered samples should be given priority. This means that added emphasis is placed on appropriate well construction methods, materials and ground-water sampling procedures. For accurate estimations of truly "dissolved" species concentrations, filtration with a nominal pore size smaller than 0.45 microns was recommended. It was further concluded that filtration could not compensate for inadequate construction or sampling procedures.

### Background/Support Information

Filtration of ground-water samples for metal analyses will not provide accurate information concerning the mobility of metal contaminants. This is because some mobile species are likely to be removed by filtration before chemical analysis. Metal contaminants may move through fractured and porous media not only as dissolved species, but also as precipitated phases, polymeric species or adsorbed to inorganic or organic particles of colloidal dimensions. Colloids are generally considered as particles with diameters less than 10 microns (Stumm and Morgan, 1981). Numerous investigators have suggested the facilitated transport of contaminants in association with mobile colloidal particles. Kim et al. (1984) suggested that sorption to ground-water colloidal material caused the mobilization of some radionuclides in Gorieben ground waters. Saffell et al. (1984) studied americium percolation in glauconitic sand columns and attributed the unretained fractions to migrating colloidal species.

\* Micron =  $\mu\text{m}$  =  $10^{-6}$  meter



### Superfund Technology Support Centers for Ground Water

Robert S. Kerr Environmental  
Research Laboratory  
Ada, OK

Environmental Monitoring  
Systems Laboratory  
Las Vegas, NV

These colloids were either homogeneous hydrous precipitates, or were formed from the adsorption of the radionuclide onto colloidal size mineral particles. Colloidal particles generated in batch experiments by Sheppard et al. (1979) were shown to adsorb significant quantities of radionuclides. Further work by Sheppard et al. (1980) concluded that the transport of radionuclides by colloidal clay particles must be considered in any contaminant transport model. Champlin and Eichenolz (1968) showed that the movement of radioactive sodium and ruthenium in sand beds was associated with particulate matter of micron dimensions. Gschwend and Reynolds (1987) demonstrated that submicron ferrous phosphate colloids were suspended and presumably mobile in a sand and gravel aquifer.

Studies by Yao et al. (1971) and O'Melia (1980) indicate that colloidal particles in the range 0.1 to 1.0 micron may be most mobile in a sandy, porous medium. Kovenya et al. (1972) concluded that particles in the range 0.1 to 0.5 mm were most mobile in soil column studies. As much as 200 ppb copper, lead and cadmium was found associated with colloidal material in size range 0.015-0.450 mm by Tillekeratne et al. (1986). Rapid transport of plutonium (Pu) in core column studies by Champ et al. (1982) was attributed to colloidal transport, with 48% of the Pu associated with colloids in the size range 0.003-0.050 mm and 23% in the range 0.050-0.450 mm. Reynolds (1985) using carboxylated polystyrene beads ranging from 0.10 to 0.91 mm in size, recovered 45% of the 0.91 mm size beads, and greater than 70% of 0.10 and 0.28 mm size beads in laboratory sand column effluents.

Lake and estuarine studies by Baker et al. (1986) and Means and Wijayarathne (1982) demonstrated the importance of natural colloidal material in the transport of hydrophobic contaminants. Carter and Suffet (1982) found that a significant fraction of "dissolved" DDT in surface waters was bound to colloidal humic material. Takayanagi and Wong (1984) found over 70% of the total inorganic colloidal particles.

Analytical methods used to determine "dissolved" metal concentrations have historically used 0.45 micron filters to separate dissolved and particulate phases. If the purpose of such determinations is an evaluation of "mobile" species in solution, significant underestimations of mobility may result, due to colloidal associations. On the other hand, if the purpose of such filtration is to determine truly dissolved aqueous species, the passage of colloidal material less than 0.45 microns in size may result in the overestimation of dissolved concentrations (Bergseth, 1983; Kim et al. 1984; Wagemann and Brunskill, 1975). Kennedy et al. (1974) found errors of an order of magnitude or more in the determination of dissolved concentrations of aluminum, iron, manganese and titanium using 0.45 micron filtration. Sources of error were attributed to filter passage of fine-grained clay particles. Additionally, filtration of anoxic ground-water samples is very difficult without iron oxidation and colloid formation, causing a removal of previously dissolved species to be filtered. Filter loading and clogging of pores with fine particles may also occur, reducing the nominal size (Danielsson, 1981). Filtration should be viewed as only one approach for determining the "true" solution geochemistry of ground water, and others should be applied whenever possible.

### Purpose of Sampling

It is important to identify the purpose of ground-water sampling before decisions regarding filtration, centrifugation or other

phase separation techniques are made. Is this to determine the mobility of contaminants, or to determine in situ aqueous geochemistry? The following definitions are also useful for consideration of this issue:

- 1) Total Contaminant Load Percent Volume of Aquifer = Mobile + Immobile Species
- 2) Mobile Species = Dissolved + Suspended Species
- 3) Dissolved = Free Ions + Inorganic Complexes + Low Molecular Weight Organic Complexes
- 4) Suspended = Adsorbed + Precipitated + Polymeric + High Molecular Weight Organic Complexes.

For an assessment of mobility, all mobile species must be considered, including suspended particles acting as adsorbents for contaminants. While not all suspended species may necessarily be sufficiently mobile or toxic to pose a health risk, a conservative approach is proposed at this time until more definitive data are available. Contaminant transport models which account for an additional aqueous mobile colloidal phase have been proposed by Avogadro and DeMarsily (1984) and Entfield and Bengtsson (1988).

A principle objective in a sampling effort for testing a geochemical speciation model is to obtain estimates of the free ion activities of the major and trace elements of interest. Since there are relatively few easily performed analytical procedures for making these experimental estimates, an alternative procedure is to test the analytically determined dissolved concentrations with model predictions including both free and complexed species. More and more remedial investigations are utilizing such models to make predictions about contaminant behavior based on dissolved concentrations. It is not the purpose of this report to suggest how to perform these analytical determinations, but as noted above, the use of a 0.45 micron filter as the operational definition of "dissolved" may be inappropriate. Analytical techniques such as ion selective electrodes, ion exchange and polarography may be more accurate. Research utilizing these and other techniques to correlate "dissolved" with filter size is recommended.

If one adopts the conservative approach with no filtration for contaminant mobility estimations, increased importance is placed on proper well construction, and purging and sampling procedures to eliminate or minimize sources of sampling artifacts.

### Sources of Sampling Artifacts vs. "real" Ground-water Environment

The disturbance of the subsurface environment as a result of well construction and sampling procedures presents serious obstacles to the interpretation of ground-water quality results. Some degree of disturbance of natural conditions is inevitable. However, the impact of improper well construction and sampling techniques can permanently bias the usefulness and integrity of wells as sampling points. Several aspects of well construction and sampling procedures must be carefully considered to avoid errors associated with the introduction of foreign particles or the alteration of ambient subsurface conditions which may affect natural dissolved or suspended materials.

## Well Construction

The design, drilling, and construction of monitoring wells have been identified as particularly important steps in the collection of representative water chemistry and hydrologic data. Several references have emphasized the minimization of both the disturbance and the introduction of foreign materials (USEPA, OSWER-9950-1, 1986; Barcelona, et al., 1983; Barcelona et al., 1985) because of the potential impact on water chemistry. The RCRA Technical Enforcement Guidance Document (USEPA, OSWER-9950-1, 1986) suggests that the well must allow for sufficient ground-water flow for sampling, minimize passage of formation materials into the well, and exhibit sufficient structural integrity to prevent collapse of the intake structure. It should be recognized, however, that the well must first provide a representative hydraulic connection to the geologic formation of interest. Without the assurance of this hydraulic integrity, the water chemistry information cannot be interpreted in relation to the dynamics of the flow system or the transport of chemical constituents.

More specific guidance is therefore necessary to maintain or restore the natural hydraulic conductivity of the formation in the vicinity of the screened portion of monitoring wells through the drilling, construction and development procedures. The literature on water well technology can be most helpful in this regard since minimal disturbances of the subsurface is a common goal in maximizing both the yield of water supply wells and the representativeness of water samples and hydraulic information from monitoring wells (Driscoll, 1986).

To insure the long-term integrity of monitoring wells, particularly with respect to excluding foreign particles and permitting the passage of mobile (i.e., dissolved and suspended) contaminants, specific items which should be observed are:

- 1) If no alternative to the use of drilling muds or fluids exists, these materials must be removed from the well bore and adjacent formations by careful well development (Driscoll, 1986). This guidance also applies to the removal of the low permeability "skin" which is caused by abrasion, oxidation and invasive muds which may seal the well bore from the screened interval and bias *in situ* determinations of hydraulic conductivity (Faust and Mercer, 1984; Moench and Hsieh, 1985; Faust and Mercer, 1985). Pumping rates during development should be documented and care should be taken not to exceed these rates during purging or sampling since further development and well damage may aggravate suspended particulate and turbidity problems even in properly designed wells.

- 2) The emplacement of grouts and seals to isolate the screened interval must be carefully done. The use of tremie pipes and frequent checking of the depth of emplacement of clay or cement grouts during well construction are strongly encouraged.

It is also important to take care to follow manufacturer's guidelines on the hydration of cement or expanding cement as grouts or seals. Excess water addition and grading of cement components or materials due to free fall through standing water can permanently damage the well's integrity (Evans and Ellingson, 1988).

- 3) Casing and screen materials must be selected to retain their integrity in the subsurface environment (i.e., avoid iron,

steel), minimize bias to water samples and insure that screen openings are not reduced by the buildup of corrosion products or by compression (USEPA, OSWER-9950-1, 1986). These effects can be checked by repeat determinations of *in situ* hydraulic conductivity over the useful life of the well. Redevelopment and replacement of the well should be considered if deterioration or significant changes in hydraulic conductivity are observed. Erratic water level readings and sudden changes in turbidity or purging behavior of monitoring wells prior to sampling are warning signs of possible loss of material integrity.

- 4) Well design fundamentals with regard to the selection of a filter pack and screen size are among the most important issues in obtaining representative hydraulic and water quality information. The exclusion of fines, clays, and silts can be achieved by selecting the grain-size distribution for the filter pack by multiplying the 50-percent retained size of the finest formation sample by a factor of two (Driscoll, 1986). The filter pack material should be cleaned and washed free of fines to insure that extraneous contaminants or particles are removed. The well screen slot openings should be chosen to retain 90% of the filter pack material after development. In natural packed wells it may be advisable to select a screen slot size which will retain at least 50% of the finest material in the screened interval. Minimizing slot screen width however, often leads to greater time and energy spent in well development. The need to document well development procedures cannot be overemphasized.

Maintenance of the hydraulic performance of monitoring wells and the connection of wells to the zones of greatest hydraulic conductivity, where contaminant transport is most probable, should take equal importance to the collection of representative water quality data.

## Purging and Sampling

Water that remains in the well casing between sampling periods is unrepresentative of water in the formation opposite the screened interval. It must be removed by purging or isolated from the collected sample by a packer arrangement prior to the collection of representative water samples. Water level readings must be made carefully to avoid the disturbance of fines or precipitates which may enter or form in the well due to chemical reactions or microbial processes and accumulate on the interior walls of the well casing screen or at the bottom of the well. Similarly, it is important to purge the stagnant water at flow rates below those used in development to avoid further development, well damage or the disturbance of accumulated corrosion or reaction products in the well. The use of certain sampling devices, particularly bailers and air-lift arrangements, should be discouraged in order to avoid the entrainment of suspended materials which are not representative of mobile chemical constituents in the formation of interest.

A note of caution should be voiced to encourage repetitive sampling of monitoring wells prior to judging the representativeness of determinations of hydraulic conductivity, water level readings and water quality data. The effects of the inevitable "trauma" due to drilling, sealing and development of monitoring wells can bias observations of water chemistry until the subsurface is allowed to equilibrate sufficiently (Walker, 1983). Estimates of the time to achieve equilibration vary substantially, particularly when drilling fluids are used in highly permeable formations.

Brobst, 1984; Onscoll, 1986); however, periods of weeks to several months may be necessary before even major ionic constituents of ground water equibrate to previous levels (Barcelona, et al., 1988).

### Recommendations for Sampling

In general, the zone of interest must be isolated, the sample pumped slowly to minimize turbidity and sample collected in such manner as to eliminate  $O_2$  and  $CO_2$  exchange with the atmosphere. No filtration for mobile metals determination is recommended. If the unfiltered values exceed maximum contaminant level concentrations for ground-water quality, additional analyses and re-evaluation of sampling artifacts are required. It should be emphasized that extreme differences between unfiltered and 0.45 mm filtered samples does not preclude the use of unfiltered data for risk assessment decisions. Significant particulate mobility may be occurring at such a site, and additional analyses with other larger filters (e.g., >0.45 mm) may be most appropriate given the current size estimates for upper limits for mobile particles.

### Isolation of Sampling Zone

Isolation of the sampling zone is necessary to minimize the purge volume as well as to minimize air contact. This is especially important since Eh/pH conditions of the formation waters are notoriously sensitive to dissolved gases content. Inflatable packers can be used to achieve isolation of the sampling zone.

### Pumping for Sample Collection

It is recommended that a positive displacement pump can be used. Other types of sample collection (e.g., bailing) may cause displacement of non-mobile particles or significantly alter ground water chemistry leading to colloid formation (e.g., vacuum pumps). Surging must be avoided, and a flow rate as close to the actual ground-water flow rate should be employed. Acknowledging that this may be impossible or impractical in some instances, a pumping flow rate based on the linear ground-water flow rate and open screen area is proposed, where

$$\text{pumping flow rate} = \text{linear GW flow rate} \times 2 \times \text{screen ht.} \times \text{well radius} \times 10$$

While an initial approximation, flow rates around 100 ml/min have been used to successfully sample ground-waters in a quiescent mode.

Additional research is needed in this area, particularly with respect to the appropriateness of this generic equation. An inexpensive flow-through type cell set-up utilizing this approach was described by Garske and Schock (1986).

### Assessment of Water Constituents While Sampling

Monitoring of the pumped ground water for dissolved oxygen, temperature, conductivity and pH aids in the interpretation or establishment of ground-water background quality. Gschwend and co-workers (personal communication) have observed that turbidity diminished dramatically after prolonged pumping, changing similarly, although possibly more slowly, than other water quality

parameters (e.g.,  $O_2$ , conductivity). An initial estimate proposed for time of pumping necessary to collect water from a formation is around two times the time required to get plateau values for the above parameters.

### No Filtration for Mobile Fraction Determination

Those samples intended to indicate the mobile substance load should not be filtered. Steps to preserve their integrity such as acidification, should be performed as soon as possible.

### Filtration for Specific Geochemical Information

Any filtration for estimates of dissolved subsurface species loads should be performed in the field with no air contact and immediate preservation and storage. In-line pressure filtration is best with as small a filter pore size as practically possible (e.g., 0.05, 0.10 micron). Using a smaller pore size filter will require longer sample collection time, increasing the need for air exclusion from the sample (Laxen and Chandler, 1982; Holm et al., 1988). Polycarbonate membrane-type filters with uniform and sharp size cutoffs are recommended to minimize particle loading on the filter. Although membrane filters are more prone to clogging than fiber-type filters, the uniform pore size, ease of cleaning, and minimization of adsorptive losses from the sample tend to improve the precision and accuracy in the analytical data. The filter holder should be of material compatible with the metals of interest. Holders made of steel are subject to corrosion and may introduce non-formation metals to samples. Large diameter filter holders (e.g., > 47 mm) are recommended to reduce clogging and pore size reduction and for ease of filter pad replacement. The use of disposable in-line filters are suggested for convenience if of sufficient quality. Prewashing of filters should be routinely performed. Work by Jay (1985) shows that virtually all filters require prewashing to avoid sample contamination.

Quality assurance and quality control becomes increasingly important when adopting the above recommendations. The use of field blanks and standards for field sampling is essential. Field blanks and standards enable quantitative correction for bias due to collection, storage and transport. Analysis of the filters themselves and their particulate load is suggested as a check on mass balance and filtration effects on solid/solution separation efficiency.

### References

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- Baker, J.E., P.D. Capel, and S.J. Eisenreich, 1986. Influence of Colloids on Sediment-Water Partition Coefficients of Polychlorodiphenyl Congeners in Natural Waters. *Environ. Sci. Technol.* 20(11):1136-1143.
- Barcelona, M.J., G.K. George, and M.R. Schock, 1988. Comparison of Water Samples from PTFE, PVC and SS Monitoring Wells. Illinois State Water Survey Internal Report Prepared for

***APPENDIX B***  
***ANALYTICAL RESULTS***

## METALS/WET CHEMISTRY DATA ASSESSMENT

PROJECT NO. 89MC114V  
LABORATORY ESE-17327K  
LAB PROJECT NO. 2353044  
NO. OF SAMPLES/  
MATRIX 12 - 2353044-2736

SITE NL/TARACORP SUPERFUND SITE

REVIEWER MICHAEL M. KELLEY  
REVIEWER'S NAME MICHAEL M. KELLEY  
COMPLETION DATE 3/7/93

## DATA ASSESSMENT SUMMARY

	ICP	AA	Hg	CN	OTHER
1. HOLDING TIMES	✓	✓	✓	✓	_____
2. BLANKS	✓	✓	✓	✓	_____
3. CCV	✓	✓	✓	✓	_____
4. STANDARD MATRIX SPIKE	✓	✓	✓	(1)	_____
5. MATRIX SPIKE	✓	✓	✓	✓	_____
6. OTHER QC	✓	✓	✓	✓	_____
7. OVERALL ASSESSMENT	0	0	0	0/x	_____

0 = Data had no problems/or qualified due to minor problems.

M = Data qualified due to major problems.

Z = Data unacceptable.

X = Problems, but do not affect data.

ACTION ITEMS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

COMMENTS: (1) SAMPLES WITH 125-DAGG ONLY AND WITH 125-DAGG AND  
140-E-2 HIGHER DDT TOTALS WERE RELEASED AS A RESULT OF DETECTION OF  
C- BUT SQUARES DATA WAS NOT AFFECTED.



ENVIRONMENTAL LABORATORY

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March 18, 1993

Dave Pate  
Woodward-Clyde Consultants  
2318 Millpark Dr.  
Maryland Heights, MO 63043



Dear Mr. Pate:

Subject: NL/Taracorp Superfund Site

Reference: 9303044 (132875-132891)

Enclosed please find a report of analytical results for seventeen (17) samples received by ORTEK Environmental Laboratory March 9, 1993. The samples were analyzed in accordance to the Chain of Custody form contained herewith. We experienced a minor anomaly during analysis, described in attachment 1. However, we do not feel the enclosed results were compromised.

Should you have any questions regarding this report please feel free to call me at 1-800-236-4067. Please have both reference numbers listed above available when making inquiries regarding this report.

Sincerely,

*Jennifer Pensoneau-Fazio*  
Jennifer Pensoneau-Fazio  
Project Manager

Approval,

*John Burnett*  
John Burnett  
Laboratory Manager

Enclosure

c: file



ENVIRONMENTAL LABORATORY

214-498-1111  
FAX 214-498-1067

**ATTACHMENT 1**

- 1) A higher detection limit was given for the selenium analysis of samples 132883-884 due to sample matrix problems encountered.

**INORGANIC CASE NARRATIVE FOR METALS ANALYSIS:   SDG WMW101**

LAB NUMBER	CHAIN OF CUSTODY I.D.	EPA NUMBER
132875	WMW112-1OGGWB	132875
132876	WMW106-DOGGOW	132876
132877	WMW107-SOGGOOW	132877
132878	WMW10992OGGOOW	132878
132879	WMW109-1OGGOOW	132879
132880	WMW10391OGGOOW	132880
132881	WMW10391OGGOOWM	132881
132882	WMW10391OGGOWX	132882
132883	WMW108-DOGGOW	132883
132884	WMW108-DOGGOWD	132884
132885	WMW104-1OGGOOW	132885
132886	WMW10492OGGOOW	132886
132887	WMW107-DOGGOW	132887
132888	WMW11192OGGOOW	132888
132889	WMW11192OGGOWD	132889
132890	WMW110-1OGGOOW	132890
132891	WMW101-1OGGOOW	132891

In order to generate the necessary forms for the requested Q.C. data, this package was assigned the SDG name WMW101. The software will not do any calculations without an SDG name. The Q.C. data was produced from our Telecations INC. EFM90 software program and was generated from the raw data. This was acceptable according to Cynthia Pavelka of Woodward-Clyde Consultants in a phone conversation with myself dated 03/10/93.

Higher less than values were reported for two samples for the Selenium analysis. In both cases, the negative instrument readings obtained exceeded the absolute value of our established method detection limit (MDL) of 3.0 ug/L. The samples affected are 132883 and 132884 which are field duplicates of each other. In an attempt to keep the less than value within the Woodward-Clyde reporting limits of 5.0 ug/L, a times 1.5 dilution was analyzed. The results were still outside the absolute value of our MDL. A times 2 and a times 3 dilution were tried with similar results. The times five

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dilution worked and was reported. In all dilutions as well as the original reading, the negative instrument readings obtained were less than the absolute value of 5.0 ug/L. Sample 132883 was Ortek's internal Q.C. sample for the Selenium analysis. The reported Selenium spike recovery of 68.3 % was done on the times five dilution and is within our established control limits for water matrices.

All analyses were performed using SW846 protocols even though the forms indicate U.S. EPA - CLP. The forms can be interpreted as follows:

**Form II (2A) is the Initial and Continuing Calibration Verification (ICV and CCVs).** These forms contain the percent recoveries of all the calibration data generated for all analytes during the analysis. Also included is the true value, the found value, and the method (M). The letter(s) "P" indicates ICP, "F" indicates AA-GF, and CV is cold vapor (Hg). They are paginated in chronological order with each page containing a maximum of two CCVs.

**Form II (2B) is the "CRDL Standard for AA and ICP".** This form contains data on a low level standard that is used to verify linearity near our MDLs. This standard is analyzed for all SW846 protocols and has an internal control limit of 50-150 %. A true value and what was found as well as the % recovery is listed.

**Form III (3) are the "Blanks" forms (ICB and CCBs).** This form contains the values for all of the initial and continuing calibration blank data (ICB and CCBs) as well as the digested preparation blank value. The values reported are our MDLs and "U" denotes not detected. The method (M) is listed and are the same as mentioned above in Form II (2A). The forms are paginated in chronological order and each form contains a maximum of three CCBs. Note: ICB and all CCB data were within three standard deviations of the mean blank value and these limits are updated three times a year using 20 previously generated data points.

**Form IV (4) is the ICP Interference Check Sample form.** This form contains a true value for solution AB, a found value, and the % recoveries. The limits are 80-120 %. These samples are analyzed to prove that the interelement correction factors as well as the background points for the 61E ICP are adequate for the SW846 Method 6010 analysis.

**Form V (5A) are the Spike Sample Recovery forms.** These forms contains the spiked sample result, the sample result, the amount of spike added, the % recovery, units, and the method. The sample that was spiked is in the box at the upper right of the form. Each form has comments that pertain to that form. All spiked sample are within control limits.

**Form VI (6) are the Duplicates forms.** These forms contain the original sample value, the duplicate sample value, units, relative percent difference (RPD) and method (M). The sample that was duplicated is in the box at the upper right of the form. All samples that were duplicated were not detected ("U"), therefore do not contain a RPD value due to the limitations of our software. The RPD would be 0.0 % difference for all analytes indicating that all duplicates were in control limits. Field duplicates were not calculated as instructed by Cynthia Pavelka.

**Form VII (7) are the Laboratory Control Sample forms.** These forms contain the true and found values as well as the % recoveries on the blank spike/blank spike duplicate (BS/BSD) that we analyze for all SW846 protocols. The control limits are 80-120 %.

**Form IX (9) is the ICP Serial Dilution form.** Since all values were not detected ("U"), there is no calculated % difference due to the limitations of our software. The % difference would be 0.0 % for all analytes.

**Hold Times.** The hold times for all analytes except Hg is 180 days. Hg has a hold time of 28 days. All sample were digested and analyzed within 8 days of receipt.



Phil Scott  
Metals Supervisor

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ENVIRONMENTAL LABORATORY

2496 West Main Street

P.O. Box 12435

Green Bay, WI 54307-3435

414-496-2222  
FAX 414-496-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132875  
Your Sample ID: WMW112-10GGWB  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/04/93 10:05 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result	Units	Analysis Date
132875	Mercury	<	0.2	UG/L	03/12/93
	Arsenic	<	3.0	UG/L	03/15/93
	Lead	<	2.0	UG/L	03/11/93
	Selenium	<	3.0	UG/L	03/12/93
	Thallium	<	2.0	UG/L	03/11/93
	Silver	<	9.0	UG/L	03/16/93
	Beryllium	<	0.6	UG/L	03/16/93
	Cadmium	<	5.0	UG/L	03/16/93
	Chromium	<	13	UG/L	03/16/93
	Copper	<	14	UG/L	03/16/93
	Nickel	<	23	UG/L	03/16/93
	Antimony	<	60	UG/L	03/16/93
	Zinc	<	20	UG/L	03/16/93

Signed *David Pate*Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

414-498-2222

FAX: 414-498-4067

2496 West Adams Street

P.O. Box 12635

Green Bay, WI 54307-3435

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132876  
Your Sample ID: WMW106-DOGG00W  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/04/93 13:25 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132876	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium		9.8 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Phil RedDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

03/17/93



ENVIRONMENTAL LABORATORY

2056 West Main Street

P.O. Box 12435

Green Bay, WI 54307-2435

414-498-1222  
FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132877  
Your Sample ID: WMW107-SOGGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/04/93 15:30 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result	Units	Analysis Date
132877	Mercury	<	0.2	UG/L	03/12/93
	Arsenic		26	UG/L	03/15/93
	Lead		87	UG/L	03/11/93
	Selenium	<	3.0	UG/L	03/12/93
	Thallium	<	2.0	UG/L	03/11/93
	Silver	<	9.0	UG/L	03/16/93
	Beryllium		1.9	UG/L	03/16/93
	Cadmium	<	5.0	UG/L	03/16/93
	Chromium		61	UG/L	03/16/93
	Copper		66	UG/L	03/16/93
	Nickel		92	UG/L	03/16/93
	Antimony	<	60	UG/L	03/16/93
	Zinc		180	UG/L	03/16/93

Signed Carl H. H. H.Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mason Street

P.O. Box 12435

Green Bay, WI 54307-3435

414-498-2222  
FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132878  
Your Sample ID: WMW10992OGGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 09:35 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132878	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Phil RestDate 5/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Main Street

P.O. Box 12435

Cotton Blg, Wt 54387-2435

414-494-1111  
FAX 414-494-1116

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132879  
Your Sample ID: WMW109-10GG00W  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 10:15 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132879	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Phil RottDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mission Street

P.O. Box 12435

Green Bay, WI 54307-3435

414-498-2222  
FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132880  
Your Sample ID: WMW10391OGGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 11:00 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132880	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Pat PateDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mason Street

P.O. Box 12435

Green Bay, WI 54302-3435

414-498-1111  
FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132881  
Your Sample ID: WMW10391OGGOWM  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 11:05 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test	Result	Units	Analysis Date
132881	Mercury	3.1	UG/L	03/12/93
	Arsenic	41	UG/L	03/15/93
	Lead	21	UG/L	03/11/93
	Selenium	26	UG/L	03/12/93
	Thallium	46	UG/L	03/11/93
	Silver	46	UG/L	03/16/93
	Beryllium	48	UG/L	03/16/93
	Cadmium	48	UG/L	03/16/93
	Chromium	180	UG/L	03/16/93
	Copper	240	UG/L	03/16/93
	Nickel	470	UG/L	03/16/93
	Antimony	510	UG/L	03/16/93
	Zinc	470	UG/L	03/16/93

Signed Phil RTHDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mason Street

P.O. Box 12435

Green Bay, WI 54302-2435

414-498-2111  
FAX 414-498-3067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132882  
Your Sample ID: WMW103910GGOWX  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 11:07 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test	Result	Units	Analysis Date
132882	Mercury	3.1	UG/L	03/12/93
	Arsenic	41	UG/L	03/15/93
	Lead	21	UG/L	03/11/93
	Selenium	26	UG/L	03/12
	Thallium	46	UG/L	03/11,
	Silver	45	UG/L	03/16/93
	Beryllium	48	UG/L	03/16/93
	Cadmium	49	UG/L	03/16/93
	Chromium	190	UG/L	03/16/93
	Copper	240	UG/L	03/16/93
	Nickel	470	UG/L	03/16/93
	Antimony	510	UG/L	03/16/93
	Zinc	480	UG/L	03/16/93

Signed DAV PATEDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mason Street

P.O. Box 12435

Green Bay, WI 54302-2435

TEL 414-498-2122  
FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132883  
Your Sample ID: WMW108-DOGGOOV  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 13:25 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132883	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead		4.3 UG/L	03/11/93
	Selenium	<	15 * UG/L	03/12/93
	Thallium		28 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium		1900 UG/L	03/16/93
	Chromium		22 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel		170 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc		7600 UG/L	03/16/93

\* - HIGHER DETECTION LIMIT DUE TO SAMPLE MATRIX PROBLEMS.

Signed Paul R. A.Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2996 West Main Street

P.O. Box 12435

414-498-2222  
FAX 414-498-4067

Canton, Ohio 44705-2435

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132884  
Your Sample ID: WMW108-DOGGOWD  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 13:30 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132884	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead		3.8 UG/L	03/11/93
	Selenium	< 15 *	UG/L	03/12/93
	Thallium		29 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium		1900 UG/L	03/16/93
	Chromium		29 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel		180 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc		7700 UG/L	03/16/93

\* - HIGHER DETECTION LIMIT DUE TO SAMPLE MATRIX PROBLEMS.

Signed Paul RayDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_



ENVIRONMENTAL LABORATORY

2496 West Main Street

P.O. Box 12435

Green Bay, WI 54307-2435

414-496-1222

FAX 414-498-4267

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132885  
Your Sample ID: WMW104-10GGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 14:05 WR/EP  
Location : NL/TARACORP SUPERFUND SITE

Lab#	test		Result Units	Analysis Date
132885	Mercury	<	0.2 UG/L	03/12/93
	Arsenic		4.6 UG/L	03/15/93
	Lead		13 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed DAVE PATEDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2494 West Mason Street

P.O. Box 12435

Green Bay, WI 54307-2435

414-498-2221  
FAX 414-498-4107

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132886  
Your Sample ID: WMW10492OGGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/05/93 15:05 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132886	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead		43 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12
	Thallium	<	2.0 UG/L	03/11/
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed *Pat R*Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Adams Street

P.O. Box 12435

Carmel, IN 46032-2435

414-498-2222

FAX 414-498-4167

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132887  
Your Sample ID: WMW107-DOGG00W  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/08/93 09:40 WR/EP  
Location : NL/TARACORP SUPERFUND SITE

Lab#	test		Result	Units	Analysis Date
132887	Mercury	<	0.2	UG/L	03/12/93
	Arsenic		24	UG/L	03/15/93
	Lead		67	UG/L	03/11/93
	Selenium	<	3.0	UG/L	03/12/93
	Thallium	<	2.0	UG/L	03/11/93
	Silver	<	9.0	UG/L	03/16/93
	Beryllium		0.6	UG/L	03/16/93
	Cadmium	<	5.0	UG/L	03/16/93
	Chromium		78	UG/L	03/16/93
	Copper		27	UG/L	03/16/93
	Nickel		45	UG/L	03/16/93
	Antimony	<	60	UG/L	03/16/93
	Zinc		91	UG/L	03/16/93

Signed *Pat R*Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

414-496-2222  
FAX 414-496-4067

2496 West Main Street

P.O. Box 12435

Green Bay, WI 54307-2435

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132888  
Your Sample ID: WMW111920GGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/08/93 10:27 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132888	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Phil RottDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_



ENVIRONMENTAL LABORATORY

2496 West Main Street

P.O. Box 12435

Green Bay, WI 54307-2435

414-498-2222

FAX 414-498-4067

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132889  
Your Sample ID: WMW11192OGGOWD  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/08/93 10:30 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132889	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Paul RottDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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ENVIRONMENTAL LABORATORY

2496 West Mason Street

P.O. Box 12435

Green Bay, WI 54307-3435

414-496-2222  
FAX 414-496-4106

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132890  
Your Sample ID: WMW110-10GGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/08/93 11:10 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132890	Mercury	<	0.2 UG/L	03/12/93
	Arsenic	<	3.0 UG/L	03/15/93
	Lead	<	2.0 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium	<	0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium	<	13 UG/L	03/16/93
	Copper	<	14 UG/L	03/16/93
	Nickel	<	23 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc	<	20 UG/L	03/16/93

Signed Phil RottDate 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

000014



ENVIRONMENTAL LABORATORY

2096 West Adams Street

P.O. Box 12435

Columbus, MO 65202-3435

417-498-1111  
FAX 417-498-4607

## - SAMPLE ANALYSIS REPORT -

To: WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR  
MARYLAND HEIGHTS MO 63043

Attn: DAVE PATE

Batch ID : 9303044  
Our Lab # : 132891  
Your Sample ID: WMW101-10GGOOW  
Sample Matrix : GRNDWATER

Report Date: 03/17/93

## COLLECTION INFORMATION

Date/Time/By: 03/08/93 11:50 WR/EP  
Location : NL/TARACORP SUPERFUNDSITE

Lab#	test		Result Units	Analysis Date
132891	Mercury	<	0.2 UG/L	03/12/93
	Arsenic		460 UG/L	03/15/93
	Lead		27 UG/L	03/11/93
	Selenium	<	3.0 UG/L	03/12/93
	Thallium	<	2.0 UG/L	03/11/93
	Silver	<	9.0 UG/L	03/16/93
	Beryllium		0.6 UG/L	03/16/93
	Cadmium	<	5.0 UG/L	03/16/93
	Chromium		77 UG/L	03/16/93
	Copper		39 UG/L	03/16/93
	Nickel		77 UG/L	03/16/93
	Antimony	<	60 UG/L	03/16/93
	Zinc		110 UG/L	03/16/93

Signed *Pat R...*Date 3/17/93

Signed \_\_\_\_\_

Date \_\_\_\_\_

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## U.S. EPA - CLP

2A

## INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Initial Calibration Source: IV

Continuing Calibration Source: SPEX

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Aluminum									
Antimony	1000.0	1035.61	103.6	5000.0	4988.93	99.8	5026.59	100.5	P
Arsenic	40.0	42.30	105.8	50.0	51.60	103.2	51.00	102.0	F
Barium									
Beryllium	50.0	50.59	101.2	50.0	49.42	98.8	49.95	99.9	P
Cadmium	1000.0	952.88	95.3	1000.0	962.95	96.3	967.94	96.8	P
Calcium									
Chromium	1000.0	957.55	95.8	1000.0	979.21	97.9	981.91	98.2	P
Cobalt									
Copper	1000.0	974.53	97.5	1000.0	988.52	98.9	993.33	99.3	P
Iron									
Lead	40.0	41.50	103.8	30.0	31.30	104.3	30.50	101.7	F
Magnesium									
Manganese									
Mercury	4.0	3.88	97.0	3.0	3.06	102.0	3.05	101.7	CV
Nickel	1000.0	985.46	98.5	1000.0	981.27	98.1	993.64	99.4	P
Potassium									
Selenium	40.0	43.00	107.5	50.0	51.50	103.0	52.40	104.8	F
Silver	1000.0	1029.58	103.0	250.0	245.95	98.4	247.96	99.2	P
Sodium									
Thallium	40.0	40.40	101.0	30.0	30.40	101.3	32.40	108.0	F
Vanadium									
Zinc	1000.0	971.97	97.2	1000.0	980.02	98.0	981.36	98.1	P
Cyanide									

(1) . Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

## U.S. EPA - CLP

2A

## INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Initial Calibration Source: IV

Continuing Calibration Source: SPEX

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Aluminum									
Antimony				5000.0	4936.98	98.7	4945.76	98.9	P
Arsenic				50.0	52.50	105.0	52.00	104.0	F
Barium									
Beryllium				50.0	48.85	97.7	49.08	98.2	P
Cadmium				1000.0	977.43	97.7	980.89	98.1	P
Calcium									
Chromium				1000.0	975.38	97.5	980.53	98.1	P
Cobalt									
Copper				1000.0	945.23	94.5	949.82	95.0	P
Iron									
Lead				30.0	30.90	103.0	30.90	103.0	F
Magnesium									
Manganese									
Mercury				3.0	3.05	101.7	3.03	101.0	CV
Nickel				1000.0	987.06	98.7	1005.71	100.6	P
Potassium									
Selenium				50.0	52.00	104.0	52.20	104.4	F
Silver				250.0	243.45	97.4	245.25	98.1	P
Sodium									
Thallium				30.0	32.20	107.3	32.10	107.0	F
Vanadium									
Zinc				1000.0	980.55	98.1	985.05	98.5	P
Cyanide									

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

## U.S. EPA - CLP

2A

## INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Initial Calibration Source: IV

Continuing Calibration Source: SPEX

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Aluminum									
Antimony									
Arsenic				50.0	49.90	99.8			F
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium				50.0	49.90	99.8	50.00	100.0	F
Silver									
Sodium									
Thallium	0.0			0.0					
Vanadium									
Zinc									
Cyanide									

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

## U.S. EPA - CLP

2B

## CRDL STANDARD FOR AA AND ICP

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

AA CRDL Standard Source: BAKER

ICP CRDL Standard Source: IV

Concentration Units: ug/L

Analyte	CRDL Standard for AA			CRDL Standard for ICP				
	True	Found	%R	True	Initial Found	%R	Final Found	%R
Aluminum								
Antimony				120.0	126.72	105.6	130.58	108.8
Arsenic	5.0	6.00	120.0					
Barium								
Beryllium				10.0	10.02	100.2	9.93	99.3
Cadmium				10.0	10.68	106.8	11.34	113.4
Calcium								
Chromium				20.0	20.07	100.4	19.67	98.4
Cobalt								
Copper				50.0	50.07	100.1	47.88	95.8
Iron								
Lead	5.0	4.40	88.0					
Magnesium								
Manganese								
Mercury	0.2	0.26	130.0					
Nickel				80.0	83.34	104.2	84.12	105.2
Potassium								
Selenium	5.0	4.60	92.0					
Silver				20.0	20.31	101.6	21.19	106.0
Sodium								
Thallium	5.0	4.80	96.0					
Vanadium								
Zinc				40.0	41.37	103.4	40.86	102.2

## U.S. EPA - CLP

3  
BLANKS

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)		Continuing Calibration Blank (ug/L)						Preparation Blank		M
		C	1	C	2	C	3	C		C	
Aluminum											
Antimony	60.0	U	60.0	U	60.0	U	60.0	U	60.000	U	P
Arsenic	3.0	U	3.0	U	3.0	U	3.0	U	3.000	U	F
Barium											
Beryllium	0.6	U	0.6	U	0.6	U	0.6	U	0.600	U	P
Cadmium	5.0	U	5.0	U	5.0	U	5.0	U	5.000	U	P
Calcium											
Chromium	13.0	U	13.0	U	13.0	U	13.0	U	13.000	U	P
Cobalt											
Copper	14.0	U	14.0	U	14.0	U	14.0	U	14.000	U	P
Iron											
Lead	2.0	U	2.0	U	2.0	U	2.0	U	2.000	U	F
Magnesium											
Manganese											
Mercury	0.2	U	0.2	U	0.2	U	0.2	U	0.200	U	CV
Nickel	23.0	U	23.0	U	23.0	U	23.0	U	23.000	U	P
Potassium											
Selenium	3.0	U	3.0	U	3.0	U	3.0	U	3.000	U	F
Silver	9.0	U	9.0	U	9.0	U	9.0	U	9.000	U	P
Sodium											
Thallium	2.0	U	2.0	U	2.0	U	2.0	U	2.000	U	F
Vanadium											
Zinc	20.0	U	20.0	U	20.0	U	20.0	U	20.000	U	P
Cyanide											

## U.S. EPA - CLP

3  
BLANKS

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L)						Prepa- ration Blank	C	M
			1	C	2	C	3	C			
Aluminum											
Antimony			60.0	U							P
Arsenic			3.0	U	3.0	U					F
Barium											
Beryllium			0.6	U							P
Cadmium			5.0	U							P
Calcium											
Chromium			13.0	U							P
Cobalt											
Copper			14.0	U							P
Iron											
Lead			2.0	U							F
Magnesium											
Manganese											
Mercury			0.2	U							CV
Nickel			23.0	U							P
Potassium											
Selenium			3.0	U	3.0	U	3.0	U			F
Silver			9.0	U							P
Sodium											
Thallium			2.0	U							F
Vanadium											
Zinc			20.0	U							P
Cyanide											

## U.S. EPA - CLP

4

## ICP INTERFERENCE CHECK SAMPLE

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

ICP ID Number: 61E

ICS Source: SPEX

Concentration Units: ug/L

Analyte	True		Initial Found			Final Found		
	Sol. A	Sol. AB	Sol. A	Sol. AB	%R	Sol. A	Sol. AB	%R
Aluminum								
Antimony		600	-13	574.7	95.8	-8	560.4	93.4
Arsenic								
Barium								
Beryllium		6	0	5.6	93.3	0	5.3	88.3
Cadmium		50	10	52.4	104.8	5	51.9	103.8
Calcium								
Chromium		150	0	131.2	87.5	-1	130.5	87.0
Cobalt								
Copper		150	12	161.6	107.7	11	154.7	103.1
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel		250	-6	209.0	83.6	-7	223.5	89.4
Potassium								
Selenium								
Silver		100	-1	85.4	85.4	-1	84.9	84.9
Sodium								
Thallium								
Vanadium								
Zinc		200	23	201.6	100.8	23	204.8	102.4

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132876S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony	75-125	495.6646	60.0000 U	500.00	99.1		P
Arsenic							NR
Barium							NR
Beryllium	75-125	48.2765	0.6000 U	50.00	96.6		P
Cadmium	75-125	47.7471	5.0000 U	50.00	95.5		P
Calcium							NR
Chromium	75-125	184.1442	13.0000 U	200.00	92.1		P
Cobalt							NR
Copper	75-125	238.5042	14.0000 U	250.00	95.4		P
Iron							NR
Lead							NR
Magnesium							NR
Manganese							NR
Mercury							NR
Nickel	75-125	486.9109	23.0000 U	500.00	97.4		P
Potassium							NR
Selenium							NR
Silver	75-125	45.8405	9.0000 U	50.00	91.7		P
Sodium							NR
Thallium							NR
Vanadium							NR
Zinc	75-125	472.2907	20.0000 U	500.00	94.5		P
Cyanide							NR

## Comments:

Ortek internal laboratory Q.C. spike sample for SW846 Method 6010.  
Control limit of 75-125 % recovery is correct.

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132878S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony							NR
Arsenic							NR
Barium							NR
Beryllium							NR
Cadmium							NR
Calcium							NR
Chromium							NR
Cobalt							NR
Copper							NR
Iron							NR
Lead	75-125	20.4000	2.0000 U	20.00	102.0		F
Magnesium							NR
Manganese							NR
Mercury							NR
Nickel							NR
Potassium							NR
Selenium							NR
Silver							NR
Sodium							NR
Thallium	75-125	45.9000	2.0000 U	40.00	114.8		F
Vanadium							NR
Zinc							NR
Cyanide							NR

## Comments:

Ortek internal laboratory Q.C. spike sample for SW846 Method 3020.  
 Disregard the 75-125 % control limit. This is the limit for CLP  
 protocols. Control limits are established by Shewhart control  
 charting and are updated every twenty points.

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132883S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER  
% Solids for Sample: 0.0

Level (low/med): LOW

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony							NR
Arsenic	75-125	34.6000	3.0000 U	40.00	86.5		F
Barium							NR
Beryllium							NR
Cadmium							NR
Calcium							NR
Chromium							NR
Cobalt							NR
Copper							NR
Iron							NR
Lead							NR
Magnesium							NR
Manganese							NR
Mercury							NR
Nickel							NR
Potassium							NR
Selenium	75-125	20.5000 B	15.0000 U	30.00	68.3	N	F
Silver							NR
Sodium							NR
Thallium							NR
Vanadium							NR
Zinc							NR
Cyanide							NR

## Comments:

Ortek internal laboratory Q.C. spike sample for SW846 Method 7060 and 7740 for Arsenic and Selenium respectively. Disregard the 75-125 % control limit as well as the 'N' flag for Selenium. The flag denotes a control failure for 75-125 % limits. See case narrative.

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132886S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony							NR
Arsenic							NR
Barium							NR
Beryllium							NR
Cadmium							NR
Calcium							NR
Chromium							NR
Cobalt							NR
Copper							NR
Iron							NR
Lead							NR
Magnesium							NR
Manganese							NR
Mercury	75-125	3.0360	0.2000 U	3.00	101.2		CV
Nickel							NR
Potassium							NR
Selenium							NR
Silver							NR
Sodium							NR
Thallium							NR
Vanadium							NR
Zinc							NR
Cyanide							NR

## Comments:

Ortek internal laboratory Q.C. spike sample for SW846 Method 7470. Disregard the 75-125 % control limit. This is the limit for CLP protocols. Control limits are established by Shewhart control charting and are updated every twenty points.

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132881S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER  
% Solids for Sample: 0.0

Level (low/med): LOW

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony	75-125	509.0948	60.0000 U	500.00	101.8		P
Arsenic	75-125	41.1000	3.0000 U	40.00	102.8		F
Barium							NR
Beryllium	75-125	48.0364	0.6000 U	50.00	96.1		P
Cadmium	75-125	47.5434	5.0000 U	50.00	95.1		P
Calcium							NR
Chromium	75-125	183.9552	13.0000 U	200.00	92.0		P
Cobalt							NR
Copper	75-125	239.0660	14.0000 U	250.00	95.6		P
Iron							NR
Lead	75-125	20.7000	2.0000 U	20.00	103.5		F
Magnesium							NR
Manganese							NR
Mercury	75-125	3.0830	0.2000 U	3.00	102.8		CV
Nickel	75-125	472.3457	23.0000 U	500.00	94.5		P
Potassium							NR
Selenium	75-125	26.2000	3.0000 U	30.00	87.3		F
Silver	75-125	46.0158	9.0000 U	50.00	92.0		P
Sodium							NR
Thallium	75-125	46.3000	2.0000 U	40.00	115.8		F
Vanadium							NR
Zinc	75-125	472.6805	20.0000 U	500.00	94.5		P
Cyanide							NR

## Comments:

Woodward-Clyde Consultants designated matrix spike. Spike recoveries calculated on sample concentrations obtained in sample 132880.

## U.S. EPA - CLP

5A  
SPIKE SAMPLE RECOVERY

EPA SAMPLE NO.

132882S

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER  
% Solids for Sample: 0.0

Level (low/med): LOW

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR) C	Sample Result (SR) C	Spike Added (SA)	%R	Q	M
Aluminum							NR
Antimony	75-125	506.2000	60.0000 U	500.00	101.2		P
Arsenic	75-125	41.3000	3.0000 U	40.00	103.2		F
Barium							NR
Beryllium	75-125	48.3984	0.6000 U	50.00	96.8		P
Cadmium	75-125	48.5630	5.0000 U	50.00	97.1		P
Calcium							NR
Chromium	75-125	185.2097	13.0000 U	200.00	92.6		P
Cobalt							NR
Copper	75-125	239.0756	14.0000 U	250.00	95.6		P
Iron							NR
Lead	75-125	20.6000	2.0000 U	20.00	103.0		F
Magnesium							NR
Manganese							NR
Mercury	75-125	3.0610	0.2000 U	3.00	102.0		CV
Nickel	75-125	473.3622	23.0000 U	500.00	94.7		P
Potassium							NP
Selenium	75-125	25.9000	3.0000 U	30.00	86.3		F
Silver	75-125	44.6811	9.0000 U	50.00	89.4		P
Sodium							NR
Thallium	75-125	45.7000	2.0000 U	40.00	114.2		F
Vanadium							NR
Zinc	75-125	476.3372	20.0000 U	500.00	95.3		P
Cyanide							NR

## Comments:

Woodward-Clyde Consultants designated matrix spike duplicate. Spike recoveries calculated on sample concentrations obtained in sample 132880.

## U.S. EPA - CLP

6  
DUPLICATES

EPA SAMPLE NO.

132876D

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

% Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum								
Antimony		60.0000	U	60.0000	U			P
Arsenic								F
Barium								
Beryllium		0.6000	U	0.6000	U			P
Cadmium		5.0000	U	5.0000	U			P
Calcium								
Chromium	10.0	13.0000	U	13.0000	U			P
Cobalt								
Copper		14.0000	U	14.0000	U			P
Iron								
Lead								F
Magnesium								
Manganese								
Mercury								CV
Nickel		23.0000	U	23.0000	U			P
Potassium								
Selenium								F
Silver		9.0000	U	9.0000	U			P
Sodium								
Thallium								F
Vanadium								
Zinc		20.0000	U	20.0000	U			P
Cyanide								

## U.S. EPA - CLP

6  
DUPLICATES

EPA SAMPLE NO.

132878D

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

% Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum			-		-		-	-
Antimony			-		-		-	P
Arsenic			-		-		-	F
Barium			-		-		-	-
Beryllium			-		-		-	P
Cadmium			-		-		-	P
Calcium			-		-		-	-
Chromium			-		-		-	P
Cobalt			-		-		-	-
Copper			-		-		-	P
Iron			-		-		-	-
Lead		2.0000	U	2.0000	U		-	F
Magnesium			-		-		-	-
Manganese			-		-		-	-
Mercury			-		-		-	CV
Nickel			-		-		-	P
Potassium			-		-		-	-
Selenium			-		-		-	F
Silver			-		-		-	P
Sodium			-		-		-	-
Thallium		2.0000	U	2.0000	U		-	F
Vanadium			-		-		-	-
Zinc			-		-		-	P
Cyanide			-		-		-	-

## U.S. EPA - CLP

6  
DUPLICATES

EPA SAMPLE NO.

132883D

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

% Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum								
Antimony								P
Arsenic		3.0000	U	3.0000	U			F
Barium								
Beryllium								P
Cadmium								P
Calcium								
Chromium								P
Cobalt								
Copper								P
Iron								
Lead								F
Magnesium								
Manganese								
Mercury								CV
Nickel								P
Potassium								
Selenium		15.0000	U	15.0000	U			F
Silver								P
Sodium								
Thallium								F
Vanadium								
Zinc								P
Cyanide								

## U.S. EPA - CLP

6  
DUPLICATES

EPA SAMPLE NO.

132886D

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

% Solids for Sample: 0.0

% Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum								
Antimony								P
Arsenic								F
Barium								
Beryllium								P
Cadmium								P
Calcium								
Chromium								P
Cobalt								
Copper								P
Iron								
Lead								F
Magnesium								
Manganese								
Mercury		0.2000	U	0.2000	U			CV
Nickel								P
Potassium								
Selenium								F
Silver								P
Sodium								
Thallium								F
Vanadium								
Zinc								P
Cyanide								

## U.S. EPA - CLP

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## LABORATORY CONTROL SAMPLE

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Solid LCS Source: IV

Aqueous LCS Source: IV

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Aluminum								
Antimony	500.0	507.27	101.5					
Arsenic	40.0	42.10	105.2					
Barium								
Beryllium	50.0	50.33	100.7					
Cadmium	50.0	50.21	100.4					
Calcium								
Chromium	200.0	196.62	98.3					
Cobalt								
Copper	250.0	250.35	100.1					
Iron								
Lead	20.0	21.50	107.5					
Magnesium								
Manganese								
Mercury	3.0	3.03	101.0					
Nickel	500.0	510.16	102.0					
Potassium								
Selenium	30.0	31.20	104.0					
Silver	50.0	49.94	99.9					
Sodium								
Thallium	40.0	40.60	101.5					
Vanadium								
Zinc	500.0	487.32	97.5					
Cyanide								

## U.S. EPA - CLP

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## LABORATORY CONTROL SAMPLE

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Solid LCS Source: IV

Aqueous LCS Source: IV

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Aluminum								
Antimony	500.0	514.01	102.8					
Arsenic	40.0	43.20	108.0					
Barium								
Beryllium	50.0	49.66	99.3					
Cadmium	50.0	48.52	97.0					
Calcium								
Chromium	200.0	196.22	98.1					
Cobalt								
Copper	250.0	249.48	99.8					
Iron								
Lead	20.0	22.50	112.5					
Magnesium								
Manganese								
Mercury	3.0	3.03	101.0					
Nickel	500.0	509.08	101.8					
Potassium								
Selenium	30.0	31.40	104.7					
Silver	50.0	49.71	99.4					
Sodium								
Thallium	40.0	39.70	99.2					
Vanadium								
Zinc	500.0	488.73	97.7					
Cyanide								

## U.S. EPA - CLP

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## ICP SERIAL DILUTIONS

EPA SAMPLE NO.

132876L

Lab Name: ORTEK

Contract:

Lab Code: ORTEK

Case No.: WWC01

SAS No.:

SDG No.: WMW101

Matrix (soil/water): WATER

Level (low/med): LOW

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Differ- ence	Q	M
Aluminum							
Antimony	60.00	U	300.00	U			P
Arsenic							F
Barium							
Beryllium	0.60	U	3.00	U			P
Cadmium	5.00	U	25.00	U			P
Calcium							
Chromium	13.00	U	65.00	U			P
Cobalt							
Copper	14.00	U	70.00	U			P
Iron							
Lead							F
Magnesium							
Manganese							
Mercury							CV
Nickel	23.00	U	115.00	U			P
Potassium							
Selenium							F
Silver	9.00	U	45.00	U			P
Sodium							
Thallium							F
Vanadium							
Zinc	20.00	U	100.00	U			P

# CHAIN OF CUSTODY RECORD

SHEET 1 of 2

WOODWARD-CLYDE CONSULTANTS  
2318 MILL PARK DR.  
MARYLAND HEIGHTS, MISSOURI 63043  
314-429-0100

406 306

PROJECT NO:		PROJECT NAME:		CONTAINER NO. OF	CONTAINER DESCRIPTION / ANALYSES REQUESTED						REMARKS	
81MCI1111		NL-17AENOCOP SUPERFUND SITE			MEAS	NOTICE	PLATE	ADD	70	70		
SAMPLER'S: (Signature)				DATE	TIME	SAMPLE I.D. NUMBER						
Newly, Robert Eric S. P.												
3/4/93	1005	WMW112-10GGWB	1	1								9303044
3/4/93	1325	WMW106-DOGG00W	1	1								132815 RITSAE PLANE
3/4/93	1530	WMW107-30GG00W	1	1								132876
3/5/93	0935	WMW10920GG00W	1	1								132877
3/5/93	1015	WMW109-10GG00W	1	1								132878
	1100	WMW103910GG00W	1	1								132879
	1105	WMW103910GG00W	1	1								132880
	1107	WMW103910GG00W	1	1								MATRIX SPIKE 132881
	1325	WMW108-DOGG00W	1	1								MATRIX SPIKE DUPLICATE 132882
	1330	WMW108-DOGG00W	1	1								132883
	1335	WMW108-DOGG00W	1	1								FIELD DUP 132884
RELINQUISHED BY: (Signature)			DATE / TIME		RECEIVED BY: (Signature)			DATE / TIME				
Eric S. P.			3/8/93 1500		Gloria Dostaler			3/8/93 10:15				
RELINQUISHED BY: (Signature)			DATE / TIME		RECEIVED AT LAB BY: (Signature)			DATE / TIME				
					Gloria Dostaler			10:15				
METHOD OF SHIPMENT:					AIRBILL NO:							
FedEx					709 35460 0.4°C							

# MIN OF CUSTODY RECORD

SHEET 2 of 2

WOODWARD-CLYDE CONSULTANTS  
2318 MILLPARK DR.  
MARYLAND HEIGHTS, MISSOURI 63043  
314-429-0100

406 306

PROJECT NO:		PROJECT NAME:		NO. OF CONTAINERS	CONTAINER DESCRIPTION / ANALYSES REQUESTED						REMARKS
89MC1144		NL / TDRACOP SURFACED SITE									
SAMPLER'S: (Signature)											
DATE	TIME	SAMPLE I.D. NUMBER									
3/5/93	1405	WMW104-10GG00W		1	1						9303044
↓	1525	WMW104920GG00W		1	1						132885
3/8/93	0940	WMW107-D0GG00W		1	1						132886
	1027	WMW111920GG00W		1	1						132887
	1030	WMW111920GG00W		1	1						132888
	1110	WMW110-10GG00W		1	1						132889
↓	1150	WMW101-10GG00W		1	1						132890
											132891
RELINQUISHED BY: (Signature)				DATE / TIME		RECEIVED BY: (Signature)				DATE / TIME	
RELINQUISHED BY: (Signature)				DATE / TIME		RECEIVED AT LAB BY: (Signature)				DATE / TIME	
METHOD OF SHIPMENT:				AIRBILL NO:		COOLER SOURCE					